GAS JOURNAL, OCT. 18, 1944

VOL. 244 96th YEAR No. 4248

EDITORIAL NOTES

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The Government has published details of its Scheme for Further Education and Training, primarily intended for the Forces, the Merchant Navy, and the Civil Defence Services, but including provision for suitable candidates whose education or training has been prevented or interrupted by employment in work of national importance other than the types of service mentioned. "Further education" is divided into three categories: Courses for those who entered on their war service before going to a university or undertaking some other course designed to equip them for their professional career; courses for those whose education has been interrupted by war service; and refresher courses for the older groups. The award to a successful applicant will be in the form of a grant enabling him to take the full course of training which he may need, the amount varying according to his existing obligations, his financial resources, and the length and nature of the course approved. It would appear that, as far as gas engineers are concerned, their requirements will be adequately covered by this scheme.

The case of the gasfitter is different. We do not know whether Government aid will be forthcoming; we do know that when the war is over an immense amount of gas installation work will cry out for attention—which means the reinstatement of fitters as quickly as possible. Further, it is unlikely that technical schools will be able to organize with the needed speed specialist courses of the type required. Gas undertakings must have not just fitters, but skilled and trained men with understanding of the new installation technique which will be demanded, developments the result of wartime planning, and agreement between the Gas Industry and the Government Departments concerned with housing. The situation, we feel, will only be met satisfactorily by effort and action on the part of individual gas undertakings—effort and action called for in the years prior to the war, but which will be doubly needed when the war is over. And once again it is good to know that the Industry has given and is giving, through the Institution, serious thought in planning a solution to this phase of the problem.

Broadly speaking, there are two classes of fitter to consider—the fully trained fitter who was working as a fitter before the war, and the apprentice or trainee fitter who was called up before his initial training as a fitter was complete. The first class, and the less numerous, will need a refresher course which, it seems to us, will have to be coupled with the acquisition of knowledge entirely new. Is such a course to precede or to be interspersed with district work, and what should be the duration of the course? The answer, to our mind, seems to depend on local exigency, and will have to be flexible rather than rigid; the overriding consideration is that, however different the methods adopted, the outcome—a thoroughly refreshed fitter capable of meeting new requirements, with all his former skill restored—shall be the same. Turning to the apprentice fitter, here again the length of course which will be necessary will depend on the extent to which training had been completed before call-up and the nature of the youth's (maybe the man's) wartime occupation. Generally, however, a longer and more complete course will be necessary.

While we have laid stress on flexibility rather than rigidity in the methods adopted to meet the problem in the immediate post-war period, while we write with no knowledge of the rate of demobilization, while we appreciate that technical schools will have problems of their own, while we see no advantage in trying to prepare standardized courses for immediate application, one point stands out—that the larger undertakings will be afforded a great opportunity of helping their smaller neighbours, and that the smaller undertakings should take advantage of the assistance offered and be prepared, in their own interests, to pay for it.

I.E.S.

THE meeting of the Illuminating Engineering Society last week, when the President, Mr. E. Stroud, gave his Address, was realistic and marked with purpose. As victory draws nearer so does the question of lighting—particularly the illumination of our streets—become proportionately of greater urgency, and as far as is possible within the limits imposed by shortage of labour and restricted supply of materials, preparations for a rapid return to pre-war lighting standards should be in hand. Considering its pre-war lighting load of 15,000,000,000 cu.ft., the Gas Industry will be called upon to play a major role in satisfying post-war lighting needs; and support of the Illuminating Engineering Society—the progress and aspirations of which are the theme of this short note—is obviously desirable, and to our mind necessary. Not that gas has not had its representation in the councils of the Society—far from it, as any record of the Society's work shows. Our point is that, with the Society's growth and likely future sphere of interest, closer and more extensive active contact, not only in London, but in the district sections, is demanded.

Founded in 1909, the volume of useful work carried out by the Society was surprisingly large during the first thirty years of its life—*i.e.*, till the outbreak of World War 2. And in most of this work the Gas Industry has had a share. In the years between the two wars the influence of the Society steadily grew. During this period the Society played a substantial part in the setting up of the National Illumination Committee of Great Britain, through which contact is maintained with the National Committees of other countries. First published in 1936, and revised constantly, the I.E.S. Code of Illumination quickly gained general recognition and is now accepted as the standard national code. Close contact has been established with the Department of Scientific and Industrial Research and with the British Standards Institution, and one may recall the work in connexion with the Ministry of Transport's enquiry into street lighting, which resulted, after three years' deliberations, in the outstanding report published at the end of 1937. Then, shortly before the war we had the setting up of the joint committee of the Society and the Ministry of Home Security to advise on lighting problems relating to the blackout—deliberations which led to the series of A.R.P. Specifications published by the British Standards Institution, apart from results which must remain secret until after the war. We may mention, too, the representation of the Society on the main Co-ordinating Committee for Codes of Practice of the Ministry of Works.

We take this glance at work accomplished because of the intentions and aspirations of the Society in regard to its future activities, intentions which have just been made known. The Society believes—with justification, we think—that, with its membership and widespread organization, it could do a great deal more post-war than has so far been within its scope. In 1910 the membership was 266, in 1932 it was 400, at the outbreak

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of war 850. The war years, however, have seen a spectacular increase, and at the present moment the membership figure stands at 1,625. The increase is attributable to the remarkable growth of the membership of the Society in the provincial areas. There are now ten Centres and five subsidiary Groups, each with its own programme; local activities are growing in scope and importance. So the Society is aiming to improve and consolidate its financial position and to enhance its status and prestige. It has laid down conditions of educational and practical attainment to which the lighting engineer of the future should conform. The fundamental education will be based on part of the City and Guilds of London Institute examination, which has been available since 1938, together with ancillary subjects. It plans to co-ordinate research, and already has set up committees to study basic problems, maintaining contact with other bodies interested in lighting research; and it has planned a programme of education of the public in the importance of lighting as a social factor. It seeks, too, to strengthen its administration. That, in barest outline, is the outlook of the I.E.S., which numerically has doubled during the war years —and with the objects we have mentioned we are sure the Gas Industry will be in sympathy.

HOUSING EQUIPMENT

IN our last two issues we have referred at some length to the contribution which the Gas Industry has made to the Government demonstration houses at Northolt. Independently of this very useful job the Industry, through the Domestic Heat Services Committee, has been co-operating for some months with the Ministry of Fuel and Power on the wider aspects of domestic fuel equipment, and from now until Nov. 4 some of the results of this co-operation are open for inspection at a Housing Equipment Exhibition in Birmingham. The exhibition, arranged by the Ministries of Fuel and Power, Health, and Works, is complementary to the Northolt houses, and illustrates those parts of the *Housing Manual* (reviewed in the "JOURNAL" of Sept. 27, p. 400) which deal with interior installations and fittings. Although gas and coke have found expression and met with approval at Northolt, the Minister of Fuel and Power had no part in the equipment of the demonstration houses because, officially, Northolt represents Government recommendations on house planning and construction, whereas the Birmingham exhibition, which was to have been held in London some months ago, but was postponed and transferred to the provinces because of the flying bombs, is the result of co-operation between all three Ministries with a view to the guidance of local authorities and others responsible for post-war housing developments.

The Ministry of Fuel and Power has made history in that this is the first time a Government Department has come out definitely on the side of improved fuel-burning appliances. Close consultation with the three major fuel industries, both on the fuel production and appliance manufacturing sides, preceded the Ministry's selection of the appliances and the fuels employed for the various domestic heat services featured in the exhibition. The Ministry required appliances for specific purposes, upon which the Domestic Heat Services Committee were requested to base their recommendations, and the exhibition includes a few full-scale gas appliances, in addition to small models of other gas appliances made by the Ministry of Works from illustrations provided by the Technical Sub-Committee of the Domestic Heat Services Committee. There are full-sized reproductions of the living kitchen, the working kitchen, and the dining kitchen as they will actually be if the Ministries' recommendations are carried out by local authorities. In addition there are five different large-scale models of the ground floor of houses based on the designs in the Government's *Housing Manual*.

This week the exhibition, which is housed in the West End Hall, 92, Suffolk Street (near the Civic Centre), Birmingham, is open only to members and officers of local authorities, public utilities, and fuel industries. Next week from Monday to Saturday it will be open to the public from 10 a.m. to 5 p.m. each day.

The Fall in Coal Output

The Minister of Fuel and Power has stated that coal production has fallen in the last six months by 5 cwt. a man each week. Colliery executives in several areas expect a difficult position this winter; and they cannot see how production can be improved without a complete revision in the attitude of many mineworkers. How to bring about such a revision is a task, it is thought, which needs not merely investigation, reorganization, and discussion such as are now proceeding, but something akin to inspiration. The task is perhaps more social than economic. Many executives never believed that increased wages would increase production—a view that might be regarded as cynical, but one based on experience and since justified in fact.

In the early part of the second quarter, as in the first quarter of the year, production was abnormally affected by disputes (particularly in Yorkshire), which, over the whole quarter, are estimated to have caused the loss of 587,400 tons, compared with a loss of 227,400 tons in the second quarter of 1943. The Easter and Whitsun holidays also reduced production.

The quarter's output was 46,422,000 tons, which compares with 47,581,300 tons in the first quarter and with 48,401,700 in the second quarter of last year. In addition, 2,322,800 tions were produced at Government open-cast workings. The voluntary absenteeism among men at the coal face in the second quarter was 5.8%, and the involuntary absenteeism 8.6%, the total being 14.4%.

Personal

Mr. A. W. Smith, C.B.E.

Mr. A. W. SMITH, one of the leading figures in the Gas Industry, will retire in March next from the position of General Manager and Secretary of the Birmingham Gas Department, having reached the age limit of 65 years. He will then have completed half a century's service with the Department.

Mr. Smith entered the employment of the undertaking in a junior capacity in 1895 and in consequence of his consistent good work and the intimate knowledge which he showed of gas undertakings' practice he was subsequently appointed Secretary to the Engineer-in-Chief, and on the reorganization of the Department in 1908 he was transferred to the Council House as Chief Clerk in the Secretary's Office. In 1913 he was appointed Assistant Secretary, and on the outbreak of war in 1914, in the absence of Capt. R. S. Hilton, who was then General Manager and Secretary, Mr. Smith took over the administrative control of the Undertaking. So successful was his work that on the resignation of Capt. Hilton in 1918 Mr. Smith was appointed Secretary of the Department, a position which he held until October, 1919, when the Gas Committee, in appointing him to the position of General Manager, said "they could find no one more fitting for the post." He was accordingly unanimously appointed to the position of General Manager and Secretary in October of 1919.

In the period of 25 years since then the growth of the Department has been phenomenal. The limits of the area of supply have been extended from approximately 75 square miles to 200 square miles and the number of consumers has increased by 160,000, while the output of gas has risen by 70%. Further, the works and distribution system has been greatly enlarged and modernized.

Apart from his local work Mr. Smith has taken an increasingly influential part in the councils of the Gas Industry. He became a member of the Gas Advisory Committee, and his other activities include membership of the National Gas Council, the Federation of Gas Employers, the Conjoint Conference of Public Utility Undertakings, the Fuel Research Board, the Benzole Advisory Committee, the British Road Tar Association, The Institution of Gas Engineers, the B.C.G.A., the British Gas Federation, the British Sulphate and Ammonia Association, the National Benzole Association, various Coke Associations, and other national and local committees. In 1943 Mr. Smith was awarded the C.B.E. in recognition of the outstanding services that he had rendered to the Gas Industry.

Mr. Smith is generally respected in the Gas Industry for his great administrative ability, and for the extensive knowledge which he brings to bear on all gas problems. His courtesy and consideration to his staff and all members of the public with whom he comes in contact have made him a popular and outstanding figure.

* * *

Mr, STANLEY HOOKER, Co-partnership Secretary of the South Suburban Gas Company, has been elected to the position of Staff Director. Joining the Company in March, 1911, he entered the Co-partnership Office and served under the first Co-partnership Secretary, Mr. F. J. Jones, who was succeeded by Mr. A. Daniel, and subsequently Mr. John Baker. Upon the retirement of the latter, Mr. Hooker was appointed in January, 1934, to fill the position.

National Gas Council

A Meeting of the Central Executive Board of the National Gas Council was held at Gas Industry House on Oct. 10, Mr. Frank H. Jones presiding.

Public Utilities Coal Committee.—Members were reminded of the request of the Ministry of Fuel and Power that the Council should put forward two or three alternative names from which they could appoint a successor to Mr. Tagg upon the Public Utilities Coal Committee. It was now reported that two out of the three previously nominated had indicated that they could not see their way to accept nomination. Two other representatives were accordingly selected, and the Ministry will be advised to this effect.

A report on the general coal position was received.

Hydrocarbon Oil Duties.—Members were reminded that, at the previous meeting of the Board, a request from the Ministry of Fuel and Power for a written statement of the Council's views on this question for submission to the Committee set up by the Government had been referred to the Council's Benzole Committee. It was now reported that the Benzole Committee suggested (acting on the recommendation of the Gas Advisory Committee) that the Government Committee should be asked to define more clearly its Terms of Reference and the scope of the enquiry which it proposed to institute.

Gas Advisory Committee to the Ministry of Fuel and Power.—A report was received from the Chairman, Mr. A. E. Sylvester, on the meeting of the Committee held the previous day, when the matters discussed had included the evidence to be submitted to the Government Committee of Enquiry into the Gas Industry; the Hydrocarbon Oil Duties Committee ; the supply of appliances; wash boilers; gas brackets; pendants and meters; purchase tax as relating to gas cookers; and the coal charges account.

Report of the Gas Legislation Committee.—A summary of members' observations on and criticisms of the Report had been circulated, and further suggestions received since the circulation of this summary were submitted. It was agreed that the Gas Legislation Committee should meet the Evidence Drafting Committee for the purpose of considering these suggestions in detail.

Association of Smaller Municipal Gas Undertakings.—A copy of the Memorandum of Evidence prepared by this Association had been circulated.

Town and Country Planning Bill.—It was reported that the Emergency Committee of the Conjoint Conference of Public Utility Associations had considered this Bill at several meetings, and that although broadly it gave effect to the proposals made by the Solicitor-General following an interview between representatives of the Council and the Solicitor-General's Inter-Departmental Committee on Town and Country Planning, some amendments were required on points of detail. These amendments had been considered by a special Sub-Committee of the Conference appointed for that purpose, and had then been moved by Mr. W. Ross Taylor, M.P. Although they were not accepted by the Government, the Solicitor-General had given an assurance that before the Bill reached the Report Stage the Ministry would meet the Conference to discuss the points raised.

During the Committee Stage, Part II of the Bill, which dealt with Compensation generally, had been withdrawn on the Motion of the Prime Minister. The Council's Parliamentary Agents had advised them that this would not affect those parts of the Bill—particularly the Fourth Schedule—which dealt with the payment of compensation to Public Utilities.

British Tar Confederation.—Copies of letters from the Association of Tar Distillers dated Aug. 15, and from the Association of Co-operative Tar Groups dated Aug. 22, had been circulated. A further letter had been received from the British Association of Coke Oven Tar Producers dated Sept. 6, tabling identical amendments to those suggested by the Association of Tar Distillers.

It was stated that it was felt that these amendments to the Constitution might be more easily dealt with when the new Executive Board of the Confederation had been established, and that the views of the Constituent Bodies would be taken with regard to this suggestion.

The Board agreed to take steps to obtain the appointment of five members to serve on the Executive Board of the Confederation in accordance with Rule VIII.

Social Insurance Scheme, Part I.—A copy of the Social Insurance Scheme outlined by the Government had been circulated. An explanatory pamphlet issued by the Minister of Reconstruction was, it was stated, also being circulated for members' comments.

It was agreed that the next meeting of the Board should be held on Nov. 14.

Scottish Eastern Juniors

A Meeting of the Scottish Junior Gas Association (Eastern District) was held in the Heriot-Watt College, Edinburgh, on Oct. 7, when Mr. T. B. Livingstone (Perth) welcomed the members and introduced Mr. W. Masterton (Edinburgh) as President for the ensuing session.

Mr. Masterton, having thanked Mr. Livingstone and the members, presented an Honorarium to the Past-President in the form of Savings Certificates.

The minutes of the previous meeting were read and approved on the motion of Mr. Doran, seconded by Mr. Alexander.

Mr. Masterton then delivered his Presidential Address, which will be reported subsequently in the "JOURNAL." A discussion followed in which many members took part.

Institute of Fuel

The Annual Luncheon of the Institute of Fuel was held at the Connaught Rooms, Great Queen Street, London, on Oct. 12. The President (Dr. E. W. Smith, C.B.E.) was in the Chair, and there was a company of some 550 members and guests. The principal guest was the Rt. Hon. Lord Woolton (Minister of Reconstruction).

Lord Woolton proposed "The Institute of Fuel." He said that British Industry was never in such need of guidance and enlightenment as it was at the present time on the subject of fuel research. Britain owed her great industrial advance to the fact that she possessed an abundance of coal. We had had coal in plenty and we had had cheap coal, the result being that we had been careless. Never did we expect a time would come when Britain would be short of coal. Yet that was the position to-day. When peace came, if we were to recover our world position the wheels of industry would have to revolve just as quickly as they did in war, and he asked the question whether we should have the coal we need to supply the wheels of industry and to keep ourselves in reasonable comfort at home? Before the war our export trade was one of our most valuable sources for purchasing foreign exchange, and we should need this in much greater volume in the post-war period than we had needed it for a generation past. There was no need to enlarge upon the vital importance of fuel efficiency throughout industry, and for the need for research upon the utilization of fuel, whatever that fuel might be—coal, gas, oil, or electricity. We wanted cheap coal, and we wanted cheaper means of using coal. Cheap coal did not necessarily mean low wages. It meant harnessing every possible mechanical and scientific device to the production of coal so that the men could earn high wages for high output. Whatever might be the pit price of coal, we must secure economies in its use in order to get cheaper production for our basic industries. The Minister of Fuel had appointed a very important technical Committee of mining engineers to report, as a matter of urgency, on the possibility of improving mining methods. There was also another important Committee to investigate the structure and organization of the Gas Industry, and the Minister of Fuel and Power had been fortunate enough to secure as Chairman of that Committee Mr. Geoffrey Heywood, who was a great industrialist. The Minister of Fuel and Power was also investigating the subject of electricity distribution, a vital factor in the structure of industry. Mention need hardly be made, also, of the Fuel Efficiency Committee under the Chairmanship of last year's Melchett Medallist, Dr. Grumel. The work of this Committee had been invaluable.

The President, responding to the toast, said there was no doubt about co-operation between the Ministry of Fuel and Power and the national bodies—the Institute of Fuel and others—to assist in bringing about in the quickest time possible the state of things which Lord Woolton had asked for. The Institute of Fuel in any case was so wrapped up with the personnel of the Ministry that it would be completely impossible to have divergent views. Therefore, there was nothing to be feared in that direction.

Lt.-Col. W. A. Bristow proposed "The Guests," coupling with the toast the name of Mr. R. W. Foot, Chairman of the Mining Association of Great Britain.

The Secretary (Mr. P. C. Pope), remarking that when the Institute started 17 years ago the membership was 420 and that it was now nearing the 2000 mark—it would reach that figure before the end of the year—said there was a good deal of excellent work the Institute could do if it had the opportunity of doing it. In an endeavour to carry out that work they had asked sundry industrial organizations to help financially by raising a guarantee fund for a period of five years, and that had been responded to very satisfactorily so far. The Institute was really an information service. It came in between the research organizations and industry, and was one of the means of translating some of the research work into practical application—which was of direct service to industry. The research organizations were assisted very materially by the Department of Scientific and Industrial Research in some proportion to the amount subscribed by the particular industry, and he was wondering whether there was some appropriate Government body which might take the hint and give the Institute a little assistance in that way on similar lines to that now given to the research organizations. The practical results of the work of the research organizations the Institute did its best to broadcast. The Institute had the experience and the knowledge, but what it wanted was the tools, and if the Government as well as the industrial organizations would help financially, he would guarantee that the Institute would make a contribution to the fuel efficiency campaign which would be of enormous national service.

Mr. R. W. Foot responded to the toast.

The Presidential Address and the Melchett Lecture were delivered in the afternoon. These will be dealt with subsequently in the "JOURNAL."

Diary

Oct. 21.—Western Junior Gas Association: Meeting at Exeter Gaslight and Coke Company's Offices, Exeter, 3 p.m.

Oct. 27.—Manchester District Association of Gas Engineers: Autumn General Meeting.

Oct. 27.—London and Southern District Junior Gas Association: Gas Industry House, 6.30 p.m. Presidential Address of R. F. Twist.

Nov. 4.—Scottish Junior Gas Association (Eastern District): Visit to Galashiels Gas-Works.

Vertical Water Tube Condensers

A patent (No. 563,073) taken out by the Whessoe Foundry and Engineering Company, Ltd., and A. G. Grant, relates to tubular condensers, and the object is to provide an improved method of and means whereby the outside of the tubes can be adequately flushed with cleaning liquid to prevent the accumulation of deposits which might impair the efficiency of the heat exchange. Broadly the invention consists of a method of cleaning the exterior surfaces of the tubes of condensers according to which separate streams of cleansing fluid are caused to pass in contact with the exterior surfaces of the tubes.

The means by which this is accomplished consists in providing a flushing control plate through perforations in which the tubes pass, a space or spaces being provided separating the exterior wall of each tube from the flushing control plate so that the cleansing fluid passes through the space or spaces in contact with the exterior surfaces of the tubes and operates to flush these surfaces. The spaces between the exterior walls of the tubes and the flushing control plate may be annular by arranging that the holes in the tube plate are of greater diameter than the outside diameter of the tubes, or the tubes can be a sliding fit in the holes and the holes serrated to provide the necessary passages.

In a vertical water tube gas condenser the top and bottom headers are water chambers and the water flows from the one to the other counterflow to the gas. The unit may either be of the single pass or multi-pass type. With such condensers the top header is normally open to atmosphere so that the water tubes can readily be cleaned by rodding out from the top. To carry out the object of this patent a second tube plate is provided a few inches below the top header and this tube plate is provided with clearance holes round the tubes. It therefore forms in effect a small chamber between itself and the top tube plate, into which a flushing medium can be introduced. It has been determined by calculation verified by experiment that if a $\frac{1}{16}$ in. annulus is formed round each tube in the manner described, when the tube plate is $\frac{1}{4}$ in. thick and the tubes have an outside diameter of $2\frac{1}{2}$ in. (the diameter of the holes in the second tube plate thus being $2\frac{5}{8}$ in.), a hydraulic head of $\frac{1}{2}$ in. above the false tube plate will result in the flushing of the outside of each tube at the rate of approximately 80 gallons per hour. This rate of flushing normally is adequate to ensure the freedom from deposits on the outside of the tubes, and such flushing would normally be carried out intermittently. It may be arranged that the whole of the tubes are flushed simultaneously or the flushing chamber may be divided into a number of compartments, preferably corresponding with the number of passes in a multi-pass type unit in order to reduce the rate of consumption of the flushing medium. In these circumstances the compartments may either be sealed the one from another, in which circumstances if desired the flushing medium may be pumped into the chamber under pressure or, alternatively, an overflow may be provided from one chamber into the next to prevent a pressure developing in any given chamber. It will be understood that the rate of flushing will be proportional to the area of the annulus provided, and will further vary according to the square root of the head of flushing medium above the annuli.

A view of the Bristol Gas Company's display at the "Black Diamonds" Fuel Economy Exhibition, which attracted over 35,000 people, held in Bristol last month.

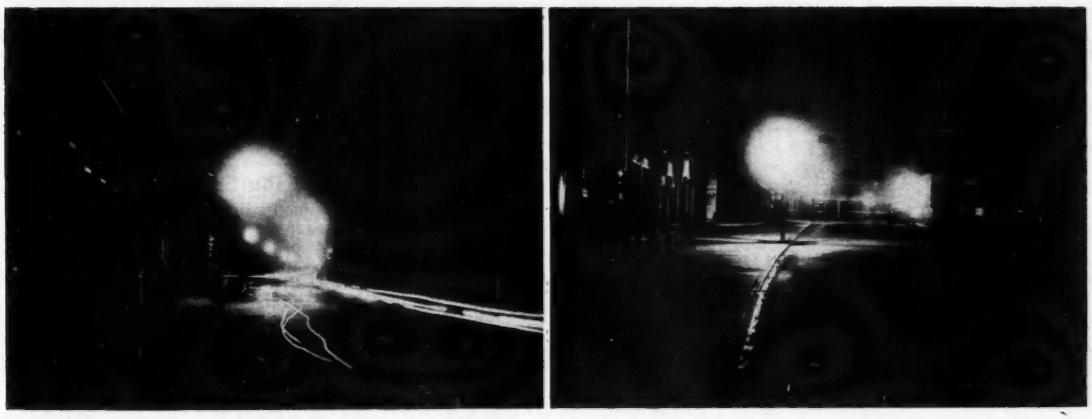
Southern Association

A General Meeting of the Southern Association of Gas Engineers and Managers was held at Grosvenor House, London, W. 1, on Oct. 11, the President, Mr. R. C. Taylor (Torquay), presiding over a very good attendance. Among the apologies for absence was one from Dr. E. V. Evans, Chairman of the Gas Research Board.

On the proposition of the President, seconded by Mr. W. A. Howie, the following were elected members of the Association: W. A. Evetts, Watford; R. W. H. Harris, East Surrey; A. G. C. Ridley, South Metropolitan; E. S. Stredwick, South Metropolitan.

The President said the main purpose of the meeting was to hear Dr. F. J. Dent, Joint Assistant Director, Gas Research Board, present his Paper on "The Production of Gaseous Hydrocarbons by the Hydrogenation of Coal." In that connexion he expressed the Association's appreciation to Dr. Evans, Chairman of the Council, and to Dr. J. G. King, Director of Gas Research, for making the Paper possible, and he would also say how pleased they were to see Dr. King at the meeting. The Paper is published in full in later pages of this issue.

After Five Years—Photographs of Street Lighting



The modified street lighting allowed by the Ministry of Home Security seems to have met with general public approval at Cambridge, thanks to the efforts of the University and Town Gas Light Company. The Company's officers and employees under the direction of the General Manager and Secretary, Mr. J. Hunter Rioch, have reason to feel proud of their achievements in so short a time. It was not until late in the afternoon of Sept. 25 that permission arrived to proceed, and on the next evening 2,169 lamps in the main highways and in the side streets were alight, and on the following night the great majority of the lamps were in action. Of the 3,145 lamps in use before the war, there were 1,009 suspension lamps used to light the main roads in the Borough, each with six burners, and 2,136 of the square type, some with four and some with two burners used to light the side streets. The new regulations allowed for one mantle only in each of these lamps, and in consequence the additional burners had to be plugged off. Just under 8,000 screwed plugs have been required for this purpose. Considerable damage to the lamps has occurred during the last five years, and wilful damage has also caused much trouble to the Company, with the result that 260 lamps had to be removed from the streets; but during the last month most of these have again been erected. Well over 400 glass globes have been replaced on the suspension lamps, while no fewer than 2,000 panes of glass were required for the square type lamps, all of which were provided from the Company's stores at short notice. One of the greatest difficulties is the replacement of lamps which have been accidentally knocked down during the war, but thanks to the special efforts made, this will not noticeably affect the efficiency of the lighting system. Something over 2,000 man-hours have been spent by employees of the Company in putting lamps in order, which has meant screening them by means of black paint and ensuring that they comply with the Ministry of Home Security's new regulations.

We publish these photographs as symbolizing a step forward to the lighting which we anticipate so eagerly after the war and for which we should be preparing now as far as is practicably possible.

The Production of Gaseous Hydrocarbons by the Hydrogenation of Coal*

By F. J. DENT, D.Sc., Joint Assistant Director, the Gas Research Board

IT is nine years since the Joint Research Committee began their investigations into the application of high pressure to gas manufacture. German work, in which gas of high calorific value had been produced from lignite by gasifying it in oxygen and steam at 20 atmospheres, had already indicated that the field offered interesting scope for development, and, as Dr. Evans has stated on previous occasions, the Joint Research Committee embarked on their exploration of it with the view that a progressive adoption of gas in place of solid fuel would ultimately give rise to the need for manufacturing processes which would enable the relative yields of gas and coke to be varied at will and which could be supplied with any type of coal.

With these aims, laboratory work commenced at Leeds University and was soon rewarded with some remarkable results. It was found that gas of high calorific value could be made rapidly by passing hydrogen, at a pressure of several atmospheres, over a wide variety of coals at temperatures up to 900°C.—the high calorific value resulting from a synthesis of gaseous hydrocarbons, chiefly methane, by the combination of the hydrogen with the coal substance. Under further examination this hydrogenation reaction continued to show considerable promise, and when the limits of laboratory working were reached it was decided to erect an apparatus of semi-works scale so as to allow the investigation of those problems which would only arise when coal was treated in bulk.

Circumstances have caused unavoidable delays in the manufacture of the special high-pressure plant but, through the efforts of the Woodall-Duckham Vertical Retort and Oven Construction Company (1920) Ltd., its erection is now complete, and preliminary tests indicate that it should answer our purpose admirably. At this halfway stage in the investigations, this Paper attempts a survey of previous laboratory work and of the problems which lie ahead.

Pressure Processes

Maintaining a high pressure during the production, purification, and distribution of gas has many remarkable features, but the one which invited our early attention was the promotion of the formation of gaseous hydrocarbons. This is, of course, at the basis of our research, since the aim to control coke production clearly depends upon gasification processes, and these require a supply of hydrocarbons if the gas made is to have a calorific value similar to that of normal town gas. The overall yield of hydrocarbons necessary is determined by what proportion of the coal is to be gasified, but if gasification is to be complete, and carried out in steam with a thermal efficiency of 70%, the amount required as methane to maintain various calorific values is as shown in Table I.

TABLE I.—THE RELATIONSHIP BETWEEN THE YIELD OF METHANE REQUIRED PER TON OF COAL AND THE CALORIFIC VALUE OF THE FINAL GAS OBTAINED BY COMPLETE GASIFICATION.

C.V., B.Th.U. per cu.ft.	Yield of methane required, therms per ton.
400	73
450	98
500	117
550	133
600	147

For comparison, the yield of hydrocarbons obtained by normal carbonization is usually about 35 therms per ton.

The influence of pressure on hydrocarbon formation can be most readily understood by appreciating that the progress of any chemical reaction requires conditions to be such that, firstly, the position of equilibrium is in favour of the desired product, and secondly, that the reaction will proceed at an adequate rate. Then, as regards the production of methane by the hydrogenation of coal, it can be said that the effect of increasing the pressure is to displace the position of equilibrium so that the reaction can be carried out at higher temperatures at which it proceeds with more vigour. This is shown by the curves in fig. 1, giving the concentration of methane in equilibrium with carbon (graphite) and hydrogen at 1 and 50 atmospheres. It is seen that an increase of temperature is against methane formation and that, at 1 atmosphere, gas with a calorific value of 500 B.Th.U. per cu.ft. cannot be made above 570°C. At 50 atmospheres, however, the corresponding temperature is 860°C.

It was the discovery that the hydrogenation of coal at 20–50 atmospheres and 800–900°C. proceeds sufficiently rapidly to make it of interest for gas manufacturing processes which was the encouraging feature of our early laboratory experiments.

The Experimental Investigation

In assessing experimental results it is of the greatest importance to take full account of the conditions under which they have been

* Paper to the Midland Junior Gas Association, the Midland Association of Gas Engineers and Managers, and the Southern Association of Gas Engineers and Managers.

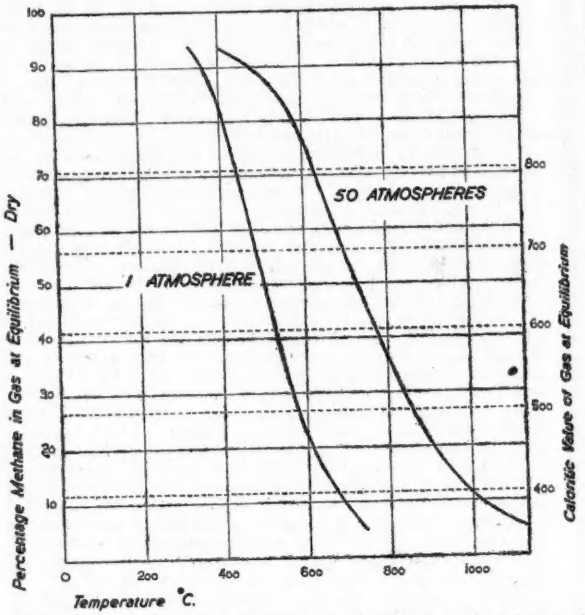


FIG. 1.—*Curves showing the percentage of methane in the mixture of methane and hydrogen in equilibrium with graphite at* 1 *to* 50 *atmospheres.*

obtained, and observations on the production of methane are no exception. Thus, in our work, a sharp distinction must be drawn between two types of experiment—*viz.*, those in which hydrogen was passed over coals contained in a reaction tube with a diameter less than 1 in., and those in which coals were treated in a larger vessel, 7 in. diameter.

The important difference in the conditions of these two cases was that, whereas in the small tube the heat which is known to be liberated during hydrogenation was readily dissipated in the 7-in. diameter vessel, once the reaction had been started by supplying preheated hydrogen, there was a sufficient bulk of coal present for the temperatures reached in it and, in particular, for the rate at which the temperature rose, to be governed by the reaction heat evolved. As will be seen, this difference had a profound influence on the results obtained.

Results Obtained with the Small Reaction Tube

The apparatus with the small reaction tube is shown in fig. 2, and the kind of results obtained is illustrated by fig. 3.

The latter shows the rate of methane production when a semi-coke was heated to 800°C. in various pressures of hydrogen, and then kept there for a period of 1½ hours. The upper broken curve indicates the rate of heating, which in this particular case was adjusted to be 2½° per minute over the period in which reactions were occurring. The rate of methane formation is shown by the continuous curves, and these are numbered with the pressure of the hydrogen supply in atmospheres. The two dotted curves at the bottom are for heating in nitrogen at 1 and 50 atmospheres.

It is seen that raising the pressure of a nitrogen atmosphere gave a notably greater yield of methane, but the most remarkable results were obtained in atmospheres of hydrogen. Then the methane production increased rapidly with the pressure until, at 100 atmospheres, the yield was more than 20 times that obtained in nitrogen at atmospheric pressure.

The methane left the reaction tube in admixture with uncombined hydrogen, the proportion of methane being sometimes more than 70% by volume during the period of rapid production. Thus, at these times, the outgoing gas was of high calorific value—*e.g.*, over 800 B.Th.U. per cu.ft.

At all pressures the reaction started at approximately 500°C. and, except at 100 atmospheres, the rate of methane production passed through two maxima at temperatures of about 550° and 750° respectively. Work on the hydrogenation of simple organic compounds indicated that the first maximum was the result of the hydrogenation of easily attacked groups on the complex molecules of the coal substance, and that the second was due to a more general reaction with

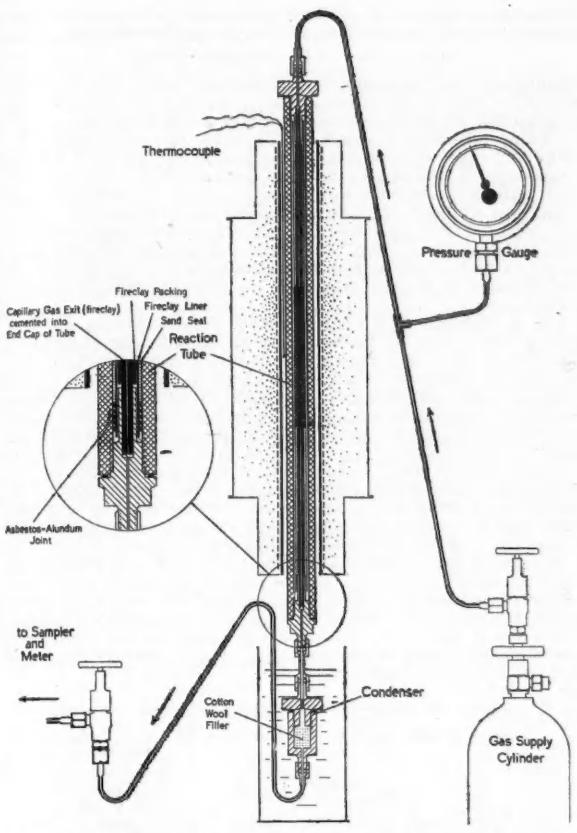


FIG. 2.—*The apparatus used to study the hydrogenation of coals and semi-coke in a reaction tube* 11/16 *in. internal diameter.*

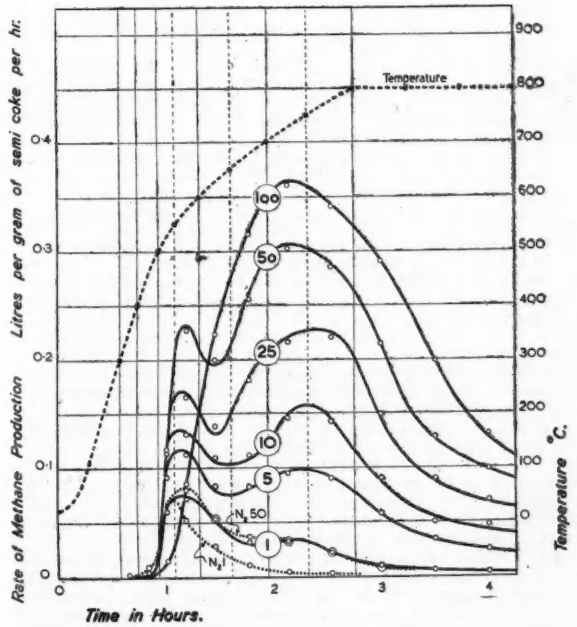


FIG. 3.—*Curves showing the evolution of methane from a coke prepared at* 450°–500°*C. from a strongly-caking Yorkshire coal, Sharlston Wallsend, during a subsequent heating in a stream of hydrogen to* 800°*C. The various curves apply to experiments made at different pressures, indicated on the curves in atmospheres. Dotted curves show the evolution of methane from the same coke on heating in nitrogen at* 1 *and* 50 *atmospheres.*

the nuclear structure. The second maximum became increasingly pronounced as higher pressures were used.

The disappearance of the first maximum at 100 atmospheres is accounted for by the pressure then being sufficiently high for the product of hydrogenation in the low temperature range to be partly liquid, as distinct from gaseous, hydrocarbons. Thus, while the rate of formation of gaseous hydrocarbons was low in this range, the rate at which hydrogen was consumed was quite normal. Further, some tarry matter collected in the receiver at the outlet of the reaction tube, although the amount was too small for accurate measurement. These observations are important, since they indicate that any considerable yield of liquid products, in excess of that obtained by distillation, is only likely to occur when the pressure is of the order of 100 atmospheres.

Another important feature of the curves is that they show that the rate of methane formation decreased rapidly when 800°C. had been reached and a steady temperature maintained. It appears that hydrogenation occurred most readily while the temperature of the coal was rising—*i.e.*, while the molecules of the coal substance were becoming increasingly unstable. The effect of the hydrogen atmosphere was seemingly to direct the course of a decomposition which would in any case have taken place. When a steady temperature was reached the coal molecules would assume a more settled configuration, less easily attacked by hydrogen.

The influence of the final temperature is shown in the next diagram, fig. 4, which gives results for the hydrogenation of a coal at 50 atmospheres, the rate of methane formation now being plotted against the percentage of the carbon present which was gasified.

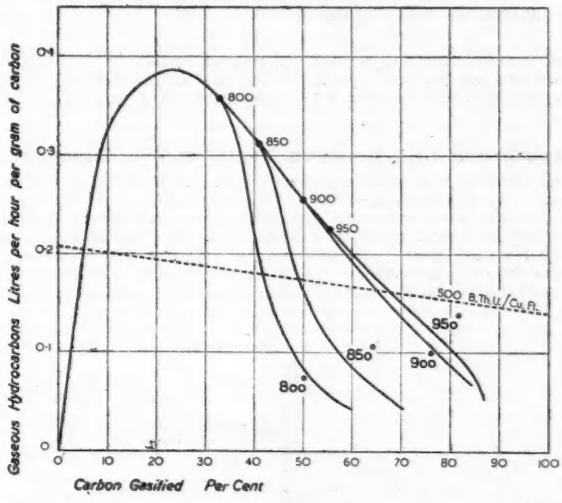


FIG. 4.—*Curves showing the evolution of gaseous hydrocarbons from a weakly-caking Yorkshire coal on heating in a stream of hydrogen at* 50 *atmospheres pressure to* 800°, 850°, 900°, *and* 950°*C. The broken curve indicates the rate of evolution necessary to produce gas of* 500 *B.Th.U. per cu.ft. under the experimental conditions.*

The curves illustrate how methane formation was better maintained at the final temperature when this was taken up to 900–950°C., and it is seen that the overall extent of gasification was then surprisingly high. 85% of the carbon was obtained in gaseous hydrocarbons. Most of the remaining 15% passed forward as liquid products, the residue in the reaction tube accounting for only 1–2%. It is important to realize that this behaviour was quite general with all the coals tried, and these ranged from almost non-caking high volatile coals, through strongly coking coals, to semi-anthracite.

Cokes prepared at low temperatures such as 500°C. gasified as readily as coals but, as might be expected, those carbonized at higher temperatures such as 800°C. were more resistant. With these cokes, however, rapid gasification was obtained in the presence of a few per cent. of sodium carbonate (see fig. 5).

Thus, the rather astonishing conclusion was reached that all the carbon in coals and many cokes can be regarded as available for reaction with hydrogen and conversion to hydrocarbons and, from these experiments, it appeared that there should be little difficulty in obtaining the yield of 100–120 therms per ton which is necessary for a complete gasification process since, for this, 30% conversion is adequate.

Coals showed a much greater tendency to fuse when heated in hydrogen under pressure than during normal carbonization at atmospheric pressure. With the exception of lignite on the one hand and semi-anthracite on the other, all the coals studied were converted into strongly coherent cokes during the early stages of hydrogenation. The coking of the coal did not prevent hydrogenation continuing to completion. This was no doubt due to the small dimensions of the

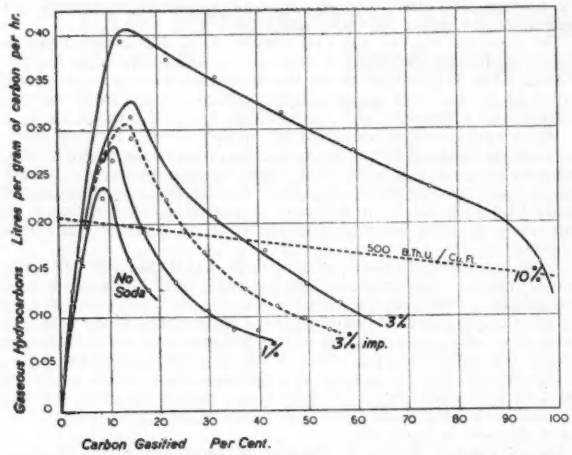


FIG. 5.—*Curves showing the influence of various percentages of sodium carbonate on the evolution of gaseous hydrocarbons from an 800°C. coke on heating to 800°C. in a stream of hydrogen at 50 atmospheres pressure. The rate of evolution necessary to produce gas of 500 B.Th.U. per cu.ft. is indicated.*

coal column used, and possible interference caused by coal fusion disturbing gas flow was regarded as the most serious difficulty to be encountered when the scale of the experiments was increased.

Experiments in a Reaction Vessel of 7 in. Diameter

Experiments in a larger vessel were undertaken for another purpose besides the examination of the effects of coal fusion. The tube experiments had shown that the temperatures required for rapid hydrogenation were higher than could be readily obtained in a large scale pressure vessel by external heating. Thus it was of primary importance to demonstrate that adequate temperatures could be generated internally by means of the heat evolved during the reactions.

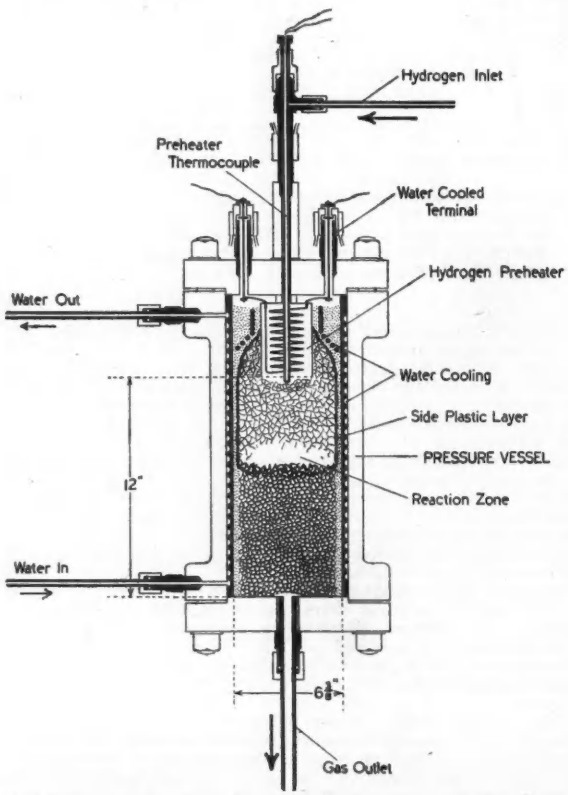


FIG. 6.—*The apparatus used for the hydrogenation of coals and semi-cokes under conditions of a self-propelling reaction zone.*

The heat of reaction for the hydrogenation of coal is not known precisely but, with graphite, union with hydrogen follows the equation,

$$C + 2H_2 \longrightarrow CH_4 + 18{,}080 \text{ calories},$$

corresponding to the amount of heat liberated being as much as one-fifth of the heat of combustion of the carbon in air. With coal it is expected that the effective evolution of heat will be rather more.

Finding conditions in which hydrogenation was self-propellant by virtue of the heat of reaction was, of necessity, the subject of the first experiments in the larger apparatus and, to avoid complications resulting from the fusion of coal, they were carried out with semi-coke.

The final arrangement of the apparatus is shown in fig. 6.

It consisted of a steel vessel, 7 in. in diameter, deep enough to take a charge 12 in. deep, and fitted with an inlet for hydrogen, means for preheating the hydrogen sufficiently to start the reaction, and an outlet for the gas produced. A refractory lining was found unnecessary.

The development of a suitable method for introducing and preheating the supply of hydrogen needed considerable experiment. The first difficulty was caused by convection currents, which were found to be abnormally pronounced in gases at high pressure. Thus, when the coke used was graded and there was little resistance to gas movement, it was observed that, if the hydrogen was supplied at the top of the vessel, there was a tendency for the gases to flow down the walls, where they were cooled to a point at which the reactions could not be supported. On the other hand, with the hydrogen inlet at the base, a remarkable chimney effect was set up and only the core of the charge was hydrogenated. Satisfactory reaction was only obtained when these convection effects were suppressed by crushing the coke to pass $\frac{1}{8}$ in. and then downward gas flow proved to be the better. The preheating of the hydrogen was initially carried out electrically, but when, in later experiments, higher rates of gas supply were used, additional heat was obtained by combustion of 3–4% of the hydrogen, oxygen being added to the hydrogen supply for this purpose.

In a typical experiment, observations of the distribution of temperature by means of a sliding thermocouple down the centre of the charge gave results like those shown in fig. 7.

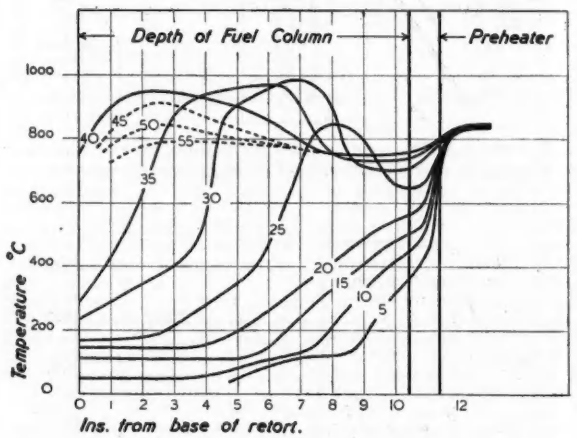


FIG. 7.—*Variation in temperature down the centre of the fuel bed during the hydrogenation at 50 atmospheres pressure of a coke prepared at 450°–500°C. from a strongly-caking Yorkshire coal. Figures on the curves indicate the time when the particular survey of temperature was taken, measured in minutes from the start of hydrogen supply.*

The preheater was maintained at 800°C. throughout, and the various curves show the temperatures in the charge at 5-minute intervals from the start of hydrogen supply.

It is seen that the temperature of the top layers of the charge rose steadily to about 650°C. when there was a sudden "kick" with the setting up of a high-temperature zone. Coincident with this, a pilot flame on the outlet gas stream assumed a white cap, indicating hydrocarbon formation. The hot zone travelled downwards and, in the particular experiment to which fig. 7 applies, reached the base of the charge 20 minutes after its initiation at the top. Then there was a period in which temperatures throughout the column settled towards that of the preheater. During the first quarter of an hour of reaction the outgoing gas contained 23% of methane, during the second quarter 49%, and in the closing stages 13%. The only other gas constituent present in any quantity was the proportion of hydrogen which had not undergone reaction. There were only traces of unsaturated hydrocarbons.

From such experiments it could be concluded that, once hydrogenation had been started, sufficient heat was made available for the propulsion of the reaction through the charge without the assistance of additional heat from external sources. But they provided further important information. They showed that, when hydrogenation was

carried out by such a self-propelled reaction zone, gasification was much more incomplete than in the tube experiments; 60–70% of the coke remained in the reaction vessel.

Clearly this was not due to the temperatures reached being insufficiently high and, indeed, the following considerations of what would happen as the reaction zone moved downwards suggests that the extent of gasification was limited as a result of too much rather than too little heat being liberated, combined with the influence of the equilibrium between carbon, hydrogen, and methane, already mentioned.

It can be taken that the lower surface of the zone would always be at about 500°C.—*i.e.*, the temperature at which the semi-coke began reacting. Below the zone the charge would be cooler while being raised to reaction temperature by the hot gases leaving the zone. Since there was excess hydrogen present throughout the charge, when 500°C. was reached at any point, that point would become embraced in the zone, and it would be by this mechanism that the zone moved downwards. Plainly there would be a simple relationship between the heat capacities of the hot gas and the fuel, the rate of gas supply, and the downward velocity of the zone.

When the zone moved down to any point, reaction commenced and the temperature started rising at a more rapid rate as methane was formed. The reaction would continue and the temperature would rise until the concentration of methane formed was in equilibrium at the temperature reached. Then the reaction at that place would stop, and calculation suggests that the observed limitation of gasification would be the consequence of the hydrogenation of only a portion of the fuel being accompanied by the liberation of sufficient heat to reach the equilibrium.

This picture of the reaction zone is supported by a number of observations. For example, it was found that the hydrogenation of coal compared with that of semi-coke gave a lower yield of methane per ton, required the supply of more hydrogen per ton, and gave an outlet gas with a lower concentration of methane. Table II gives actual results obtained at 50 atmospheres.

TABLE II.—Results Obtained with Coal and Semi-Coke.

	Yield of methane, therms per ton.	Hydrogen supplied, cu.ft. per ton.	Max. conc. of methane in outlet gas, %.
Coal (Warrenhouse) .	135	62,500	28
Semi-coke (prepared by carbonizing Warrenhouse coal at 500°C.)	158	42,500	46

These can be explained as follows: The lower yield of methane from coal would be the result of part of the coal substance being distilled away below 550°C. In consequence, per ton of original charge—and it is on that basis that the yields are expressed—there would not be as much material present when reaction started and less heat and, hence, less reaction would be required to raise the temperature up to the equilibrium point. On the other hand, more hydrogen would be required to propel the reaction through coal, since the hot gases leaving the reaction zone would have to effect the initial distillation up to 500°C. before the zone could move forward. The smaller yield of methane and the greater supply of hydrogen would account for the methane being present in the outlet gas in lower concentration.

Another supporting observation was that the presence of carbon monoxide in the gas used for hydrogenation reduced the yield of methane to a greater extent than could be explained by mere dilution of the hydrogen. Thus with 15% of carbon monoxide in the hydrogenating gas the yield of methane was lowered 20%. This influence of carbon monoxide can be attributed to the fact that its presence enables methane to be formed by an alternative reaction—*viz.*:

$$CO + 3H_2 \longrightarrow CH_4 + H_2O + 49{,}270 \text{ cal.}$$

This reaction is nearly three times more exothermic than the direct union of carbon and hydrogen and, in so far as it takes part, the final equilibrium temperature is reached more readily.

It is not wished to overstress the result of the attainment of equilibrium, because it is not anticipated that it will prevent the production of sufficient methane for this investigation. It is, however, important to point out that, when fuels are hydrogenated in bulk and conditions do not allow the reaction heat to be readily dissipated, the yields of methane are entirely different from those obtained during treatment in small reaction tubes.

It may be mentioned, however, that it might not be necessary to accept the limitations as they have been outlined. Thus, equilibrium temperatures would not be reached so rapidly if it were possible to absorb the heat evolved during hydrogenation by, *e.g.*, superimposing an endothermic reaction. The reaction between steam and coke immediately appears suitable, and the proposal would then be to add steam to the hydrogenating gas. It has not been possible to test the influence of steam thoroughly in the laboratory, but preliminary indications were that it was not as effective as was hoped, the decomposing of the steam appearing to be retarded by the presence of the hydrogen. The addition of alkali might help considerably, however, since it catalyses both the steam and hydrogenation reactions and, at the moment, the question remains as one to receive attention in the forthcoming semi-scale tests.

Reference has been made to the results given by coals, but the method of obtaining them has not yet been mentioned. Initially there was some difficulty due to caking, and quite a number of experiments were made before hydrogenation proceeded satisfactorily and evenly. The early attempts failed, due to the formation of an impenetrable layer of fused material below the entrance of the preheated hydrogen, the layer extending sideways, and causing the hydrogen to channel towards the vessel wall, where it cooled. Reaction then ceased.

Success was only achieved by separating all materials below $\frac{1}{8}$ in. from the coal, and filling the reaction vessel in such a way that there was a narrow annulus of this small grade material surrounding the main charge. It was then found that during hydrogenation the charge remained open to gas flow, and the only impervious plastic zone was formed in the fines round the periphery, where it performed the useful function of preventing the reacting gases being cooled by contact with the vessel wall. It might appear strange at first sight that a better insulation of the gases was obtained when the vessel wall was water cooled, but the effect was due to the plastic layer in the fines being made more stable.

When the reaction vessel was filled in the manner described all types of coal were treated satisfactorily, and the rate of hydrogenation was progressively increased by using higher rates of hydrogen supply until, with 1,500 cu.ft. of hydrogen per square foot per hour, the reaction zone passed through a charge 12 in. deep in from 5 to 10 minutes.

Grading the charge is not an ideal procedure for commercial operation, but it is of primary importance to know why it was effective. A reason was suggested by the appearance of the solid residue. It was found that, even when using coals which are normally regarded as strongly caking, so long as the individual pieces were greater than $\frac{1}{8}$ in., they could still be identified in the residue although they were somewhat deformed. There were few signs of the pieces adhering one to another. This was all the more surprising since, in the tube experiments, coals had shown an increased tendency to fuse when heated in an atmosphere of hydrogen under pressure.

It is believed that the different behaviour was dependent upon the rate at which the temperature rose being many times more rapid when a zone of reaction was transmitted through the coal than when the coal was heated in the small reaction tube. For example, in the reaction tube the rate of heating was only about 2½° per minute, whereas in the reaction vessel, with the high gas velocities just mentioned, the temperature in the gases at any one point must have risen from 300 to 900°C. within a period of about 1 minute. It is conceivable that, with such high rates of heat application, the coking of the outside of the individual pieces would be appreciably more advanced than that of the inside and that, so long as the effect was exaggerated by the pieces being above a certain size, they would rapidly become covered with a skin of coked material which would prevent them agglomerating if and when they did swell at some subsequent stage. As a result, layers impenetrable to gas flow would not be formed.

The Nature of the Hydrogenation Reactions

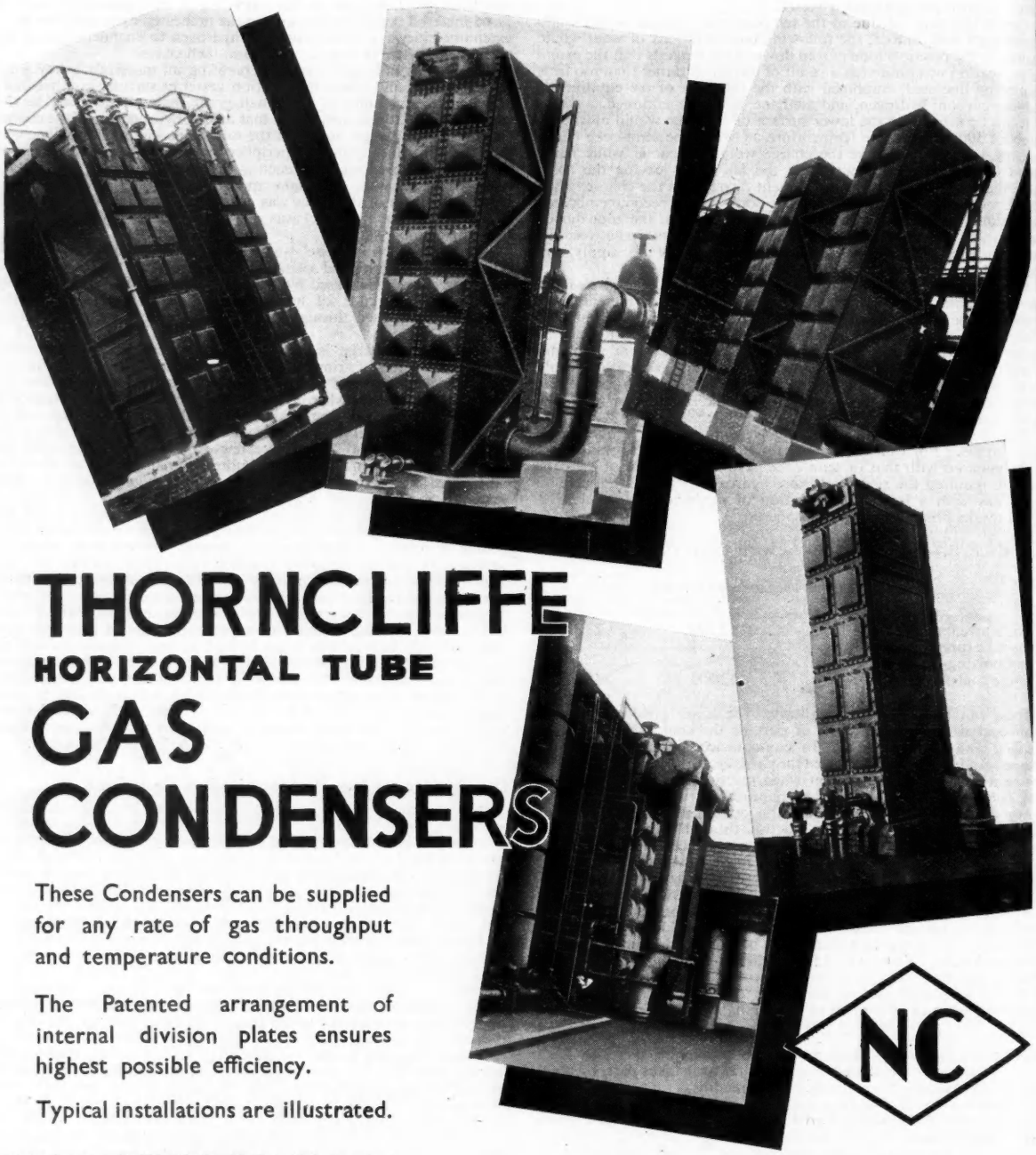
The experiments in the vessel of 7 in. diameter modified our views concerning the hydrogenation reaction. Rather than it being regarded as a method of converting solid fuels to gaseous hydrocarbons, it is now considered to be the means of transmitting a wave of high temperature through coal, and so carbonizing it by internal heating under conditions which give rise to a high yield of hydrocarbons. The process differs from other proposed methods of internal heating in that, due to the nature of the reaction occurring, the development of the heat is always confined to that part of the charge which is actually coking. Once high temperatures have been reached at any point the reaction ceases or, rather, moves forward towards uncoked material. On this characteristic depends the extreme rapidity with which hydrogenation can be carried out, and its effect may go far towards counteracting the initial cost of pressure plant by allowing it to operate at very high output.

Against this view of the hydrogenation reaction may be advanced the argument that it is merely the result of our particular method of carrying it out, and that it would not apply if the coal had been hydrogenated while at a steadily rising temperature. It is known, however, that under such conditions the whole charge would go plastic, and it seems probable that there would be difficulty in obtaining a distributed gas flow through it without the addition of some vehicle as is used in hydrogenation when carried out for the production of liquid hydrocarbons. This procedure does not appear to be suitable for gas manufacture. Our observations have led to a method of dealing with all types of coal without such complication. So far as we know the principles involved, are new and the first thing to do seems to be to exploit them.

As every investigator knows, however, the results of experimental work lead to many changes of opinion, and the future might have surprises in store.

The Application of the Hydrogenation Reaction to Town Gas Manufacture

It is too early to have definite views on the application of the hydrogenation reaction to town gas manufacture. Nevertheless, there are certain fundamental considerations which can be mentioned. One of the most important is that ultimate developments will undoubtedly depend to a great extent upon the nature of the solid residue from the treatment. Certain properties of this residue are known: it is finely



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porous, low in sulphur, and while being free from tar and volatile matter, it is highly reactive. These immediately suggest that it might be particularly suitable for the open grate, for transport producers, or for water gas manufacture. The fact remains, however, that it has not yet been obtained in sufficiently large and strong pieces for any of these purposes and, from the previous discussion of the behaviour of coal during hydrogenation, it seems quite likely that this will be difficult if securing satisfactory gas distribution in the reaction zone requires conditions in which individual particles do not coalesce. Still, a 7-in. vessel offers little opportunity to make a large coke, and the problem is regarded as open for further experiment.

At this stage the only outlet for the solid residue which can be assumed with some certainty is gasification with oxygen and steam in a high-pressure generator, a characteristic and important feature of this kind of generator being that it will deal with fuel graded almost down to dust. The gas obtained thereby would, after purification, consist essentially of 75% hydrogen and 25% carbon monoxide, and could be used for the hydrogenation of the coal. Thus, so long as the hydrogenation yielded 100–120 therms of gaseous hydrocarbons per ton of coal, and the indications are that this yield will be obtained, the two stages of hydrogenation and gasification could be combined to give a system of complete gasification.

Such a system is shown in fig. 8.

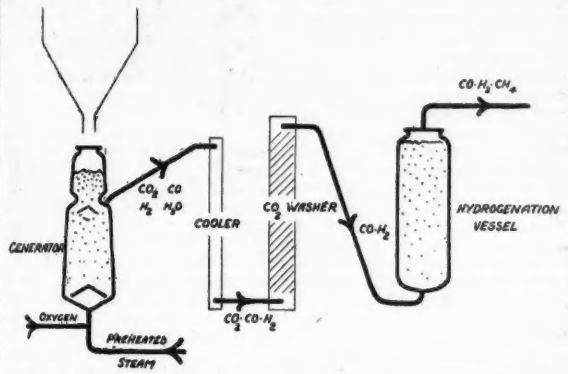

FIG. 8.—*Diagrammatic representation of a complete gasification system.*

Alternatively, if the hydrogenation stage were made continuous, it could be carried out in a retort superimposed on the gasification chamber and feeding directly into it (fig. 9).

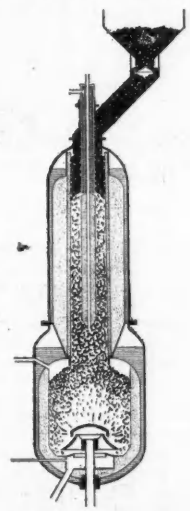

FIG. 9.—*Diagram of a continuous gasification unit.*

It is expected that such processes would operate at an overall thermal efficiency of at least 70% including the manufacture of the oxygen required, giving, per ton of coal, 220 therms of gas with a calorific value of 450–500 B.Th.U. per cu.ft.

A second important feature which will determine the application of the hydrogenation reactions is the minimum pressure at which they can be carried out. So long as pressures of 50 atmospheres are used, the most economical way of obtaining the pressure is likely to be by means of high-pressure gasification, and then oxygen will be required. If, however, the pressure could be materially reduced, it might be permissible to prepare the gas for hydrogenation by the mechanical compression of water gas or coal gas made by normal methods. This would eliminate the use of oxygen and, by doing so, would make the process more suitable for erection in small units. But it should be emphasized that any such arrangement depends upon the solid residue being suitable for the production of the water gas or some other purpose.

Experiments in the 7-in. vessel have only been made at 50 atmospheres—laboratory supplies of hydrogen became scarce before tests could be extended to lower pressures. There are, however, the results from the reaction tubes, and these show that 10 atmospheres was sufficient to give the yield of methane required. It remains to be seen how closely this performance can be approached under conditions of a self-propelling reaction zone.

The Semi-Scale Plant

It is hoped that these remarks have given the impression that the investigation of hydrogenation is still quite "fluid," and that there is a lot of work to be done on the new plant. It would be well to point out that this plant is much more a large piece of apparatus than a small commercial unit, its design aiming at no more than the investigation of those technical problems which only appear when the scale of operation is increased. For this purpose it matters little if it takes much longer to fill the generator than to hydrogenate the charge in it and, indeed, that will be the case. The arrangement of the plant is very similar to the laboratory apparatus, except that it will now be possible to treat a coal bed 12 in. diameter and 8 ft. long.

The programme of tests to be made in the plant will be somewhat as follows:

1. To investigate the influence of pressure, rate of hydrogen supply, alkalis, and steam, on the hydrogenation reactions.
2. To see whether it is possible to transmit the reaction zone through a wider and longer charge than has hitherto been used.
3. To investigate factors which influence the physical condition of the solid residue.
4. To obtain quantitative data on the yields of liquid products and to investigate methods of increasing them.

Then there are such matters as developing continuous operation, using coal in the pulverized form, &c.

With such a programme it will be agreed that the research staff are to have a very busy and interesting time.

In conclusion the Author thanks the Director and Council of the Gas Research Board, and the Joint Research Committee, for permission to publish this Paper describing work carried out by their staff.

The Autumn Meeting of the Manchester District Association of Gas Engineers will be held at the Midland Hotel, Manchester, at 2 p.m. on Friday, Oct. 27, when Mr. George E. Currier, Engineer and Manager, City of Bradford Gas Department, will read a Paper entitled "The Gas Industry—Four Major Problems."

Addressing a Meeting of Liverpool business men on Oct. 12 Sir Miles Thomas, Vice-Chairman of the Nuffield organization, said: "The existence of a magnificent system of electric grid distribution throughout the country turns one's thoughts, perhaps naturally, to a scheme of the same sort, on however modified a scale, for the gas we must use in our factories. A high-pressure gas grid is no dream: it can be developed as an economical reality, a modern means of thermal transportation. In this respect, we might be enabled to break away from the intense localization of industry that has led to some of the worst features of our urban life."

On Oct. 12 presentations were made by the Directors, staff, and workers of Keith Blackman, Ltd., to three employees who had each completed 50 years' service with the Company. The employees were Mr. Robert W. Sharrow, Drawing Office Chief; Mr. George Cobring, in charge of the mechanical fitters; and Mr. Tom Law, turner. The meeting was presided over by Mr. M. Burningham, Deputy-Chairman and Financial Director (who himself started with the Company in 1896), and the presentations were made by Major G. F. Herron, Senior Member of the Board, who has been a Director for 43 years. Mr. Sharrow received a modern grandmother clock, Mr. Cobring a gold pocket watch, and Mr. Law a gold wrist watch. In addition each received a cheque.

The Women's Gas Council co-operated with the London Regional Domestic Fuel Economy Campaign Advisory Panel in a one-day exhibition of wartime and early post-war domestic fuel economy and efficiency, held under the auspices of the Ministry of Fuel and Power at the Royal Institute of Public Health and Hygiene on Oct. 12. Throughout the day there were frequent demonstrations of lagging tanks and pipes, briquette making, meter reading, maintenance and repairs, and homely advice was given on the economical use of gas for cooking and room heating. Film shows, including the B.C.G.A. film "It Comes from Coal," were given in the morning and afternoon, and at the afternoon session Mr. W. G. Nott-Bower, Joint Deputy Secretary of the Ministry of Fuel and Power, spoke on fuel economy in the home. Visitors to the exhibition included organized parties of girls from London secondary and continuation schools. The public view of the exhibition was preceded by a two days' fuel economy instructional course for delegates from London sections of women's organizations, opened by Mr. Tom Smith, M.P., in the unavoidable absence of Sir John Dalton, Regional Controller.

Area Gas Supply

Discussion on a Paper to the Wales and Monmouthshire Association of Gas Engineers and Managers by W. Hodkinson and H. B. Taylor. See "JOURNAL," October 4 and 11.

The President (Mr. W. T. Kenshole, Merthyr Tydfil) said the Paper was both stimulating and encouraging, envisaging as it did the means whereby new methods and a new gas technique might be developed throughout their area without loss of individuality, by making available an abundant supply of constant quality gas at a reasonable price. There could be no doubt that availability of supply was one of the dominating factors to which they must look, because without that the Gas Industry would not be able to play its full part. Such a scheme would produce that cohesion which was so necessary for future development. The majority of the members were deeply interested in a grid scheme, and the Paper provided a very solid basis for discussion.

Mr. **R. J. Auckland** (Cardiff) said that he had been surprised to find that some remarks he made on an earlier occasion when gas grids had been discussed had been interpreted as an indication that he was out of sympathy with the idea of a grid. He wanted to take the first opportunity of saying he was wholeheartedly in support of such a project, and he would like to say on behalf of his Company that they were not only willing and desirous, but they really wished to have an opportunity of considering a suitable supply of coke oven gas at a suitable price. When they looked at the schedule of undertakings in the Paper they would see that that at any rate was a very good basis on which such a scheme could be arranged in South Wales. He did not know how the figures were worked out, but these figures alone showed that Cardiff represented upwards of 30% of the total demand in the area. It was not surprising that this subject had been chosen for discussion in a year in which their immediate Past-President, Mr. Muir, had occupied the chair, for he had had a long and successful experience of supplying no gas at all from his works, but all of it from coke ovens. He paid tribute to the Authors both for the subject-matter of their Paper and for the manner of its presentation. Reference had been made to the memorandum by Colonel Carr which was presented to the South Wales gas undertakings last year. There had been some speculation as to the amount of coke oven gas likely to be available, and he noticed from the Paper that the Authors had reverted to the previous estimate. He was all in agreement with the principle that first things must come first, and the first thing was to ascertain the size and source of the available supply. Clearly the Association was not the appropriate body to take action, but it was up to them to inform those who were able to take action and to exert any influence they could towards the desired end. From his first brief reading of the Paper it seemed to him that the chief alternative to the suggested grid drawing its supplies from the coke ovens was to have a large centralized gas-works, but the main body of the Paper went on to contemplate coke ovens as the source of supply. Far be it from him to enter into the relative merits of manufacture. As a commercial man he asked which of these two plants was the more likely to eventuate, in a reasonable space of time, in the greatest benefit to the Industry. There were those who claimed that it was by no means certain that all the factors were on one side. He was inclined to the view that the reply to the commercial man's question was that coke ovens would be the speedier horse, and therefore from his point of view, the one to back. It would be a disaster if the impression were allowed to arise that there was any difference of any kind in the ranks of the Association about taking the most readily available supply. The present-day levels of costs of materials of construction had a serious bearing upon the position, and there were also questions as to the availability of materials, quite apart from cost levels. Finally he called attention to the remark in the Paper that there were a number of new sites for coke ovens in the area with excellent coal reserves, at one of which preliminary work was advanced. That was a most encouraging statement, and it was certain that other projects were very definitely receiving consideration. It was to be hoped that these examinations of the situation would lead to a favourable view being taken of the practicability and soundness of such projects. He felt that the invitation the members of the Association received to attend the meeting of the Coke Oven Managers' Association in April might not have been devoid of significance. The problem of standby plant and auxiliary gas-works plant must always remain very much in their minds, but much would depend on the number of coke ovens comprising the grid, and upon the nature and duration of the arrangements which it might be found possible to make.

Mr. **H. B. Taylor**, replying first to the question of the amount of gas available, said there was in fact hardly any surplus gas in the area. The point was that coal was being carbonized in coke ovens without making surplus gas available. If they carbonized the same total quantity of coal as was now being carbonized in the coke ovens and gas-works in the area, and did it on the right lines, they would have a total gas available of 1939 total, plus 80%. Present inefficient batteries would have to be reconstructed as modern compound ovens designed to make gas as well as coke. In comparison with the original scheme put forward last year, the only difference they had made was to reduce the rate of interest taken for the purpose of the administration costs. They had aimed at being on the high side with all their estimates; if they went too low they would only have been shot at. The scheme suggested 18 months ago mentioned interest charges which might not be available in the post-war period, but they thought the rates now put foreward would be available and acceptable in the post-war period. He thought that was the only major difference, but there was one other point; they had included rather more for unaccounted-for gas, taking a figure of 7%; otherwise the estimates were very much the same. The possible installation of coke ovens at gas-works was another aspect. They put forward coke ovens as a basis for discussion, and they said they could make gas in coke ovens at the figures given in one of the tables, on the basis of certain assumptions. They quite appreciated there were other forms of carbonizing plant, which would make gas at certain figures. Obviously they had not had time to go into other methods, but they had tried to point out the things that would have to be considered, and, taking certain known forms of plant, had indicated what they considered to be the best system.

Mr. **E. Ablett** (Swansea) said the proposition greatly interested a number of them in that area. They had been discussing it for some considerable time, and as far back as June of last year the Post-War Planning Committee passed a resolution to the effect that the gas interests in that area could best be served by a gas grid. At the moment he was not concerning himself with the question as to whether the manufacturing plant should be modern coke ovens or gas-works; he did not think the present was the time to consider that aspect. The Paper contained a great wealth of detail, and he would like to congratulate the Authors upon their work. What he was concerned about at present, as a technical man, was when, how, and by whom were they going to hammer out this idea of a gas grid. As Mr. Auckland had said, they had been at it for 18 months or more, and frankly they had not got very much further. The Authors had pointed to the benefits which were to be obtained by certain undertakings by way of the relief from the carrying out of major extensions which the creation of the grid would bring. They had emphasized that the full economics of the gas grid was dependent on 100% membership, and the time factor in this question was therefore very important. By whom, and how, were not quite the questions for him to answer, but he felt they were the major problems for a meeting of that kind. There was the question of ownership, which might be left until they got some guidance from the published report of the new Government Committee. He hoped that some part of the discussion might be devoted to the question of when, how, and by whom they were going to hammer something concrete out of this idea of a gas grid for South Wales.

Mr. **Hodkinson** said the scope of the Paper was not intended to cover the question of ownership, or who would do it, or how. The point they wanted to bring out was the vitally urgent necessity for examining the proposals in detail. They knew that at the end of the war they were going to be faced with keen competition from imported crude oil. Coal prices had increased by 100% since the war began, but the cost of fuel oil taken from the ground had not increased in the same way. The only increase on oil prices had been due to freightage and insurance, and at the end of the war freightage and insurance would be reduced, so that, with 100% on their coal prices, they would probably be faced with competition from fuel oil costing, if anything, less than in 1938–39. He did not see how they were going to meet that competition with their present economic structure, and therefore he suggested most seriously that this problem had to be tackled.

(To be concluded)

The Institution of Chemical Engineers are now inviting applications for their Associate Membership Examinations for 1945. Full details are given in our advertisement columns, and applications should be sent in before Dec. 1.

The Joint Chemical Committee on Patents has published a memorandum of the evidence which it has submitted to the Board of Trade Committee on Patent Law Reform. The Committee, of which Mr. A. J. Holden is Secretary, includes representatives of the Association of British Chemical Manufacturers, Biochemical Society, British Association of Chemists, Chemical Society, Institution of Chemical Engineers, Royal Institute of Chemistry, Society of Chemical Industry, and Wholesale Drug Trade Association, and the evidence is confined mainly to points which apply particularly to chemistry and chemical industry. Stress is laid on a reduction in the number of invalid patents and suggestions for a special patents section of the High Court. The question of monopolies and licences of right has already received so much attention that it is dealt with only briefly in a minority report by indicating support of statements already issued by the Chartered Institute of Patent Agents and Imperial Chemical Industries, Ltd. Copies of the memorandum (1s. post free) are obtainable from the Association of British Chemical Manufacturers, 166, Piccadilly, London, W. 1.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

Products Prices—Stocks and Shares

The London Market Oct. 16.

The prices of Coal Tar Products are unchanged.

A Government Order came into effect on March 1 controlling the price of Benzole and Coal Spirit and replacing the Control of Coal Tar Naphtha and Xylole Order, 1943.

The Order is known as the Control of Benzole and Coal Spirit Order, 1944 (S.R. & O. 1944, No. 172).*

By this Order the price of Motor Benzole is fixed at 2s. per gallon. The Order also lays down the method of evaluating Crude Benzole.

The Order also calls for periodical returns to the Ministry of Fuel and Power from all producers of Crude and Refined Benzole.

In connexion with the Coal Tar products market, the Government Order designated the Contol of Toluene (No. 4) Order, 1944 (S. R. & O. 1944, No. 170), contains an amendment of the Control of Toluene (No. 3) Order, 1943.

Attention is called to a new Government Order, which amends the price of Toluene as from Sept. 1, 1944. The Order is entitled, The Control of Benzole and Coal Spirit (No. 2) Order, 1944 (S. R. & O., No. 988).

The only change in connexion with the prices of Coal Tar Products refers to Naphthalene. A new Government Order, entitled the Coal Tar Products Prices (No. 2) Order, 1944 (S. R. & O. 1944, No. 1051), allows increases in the maximum prices for all forms of Naphthalene. The new Order came into force on Sept. 22, 1944.

* Slightly amended by Control of Benzole and Coal Spirit (No. 2) Order, 1944, which amendments came into force on Oct. 1.

The Provinces Oct. 16.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's. 2s. to 2s. 2½d., pure, 2s. 9d. (now controlled by S. R. & O. 1944, No. 988, operative from Sept. 1, 1944. Benzole and Coal Spirit, also Coal Tar Naphtha and Xylole, are now controlled by the Control of Benzole and Coal Spirit Order, 1944, dated Feb. 18, 1944, S. R. & O. 1944, No. 172, operative from March 1, and S. R. & O. 1944, No. 988, part 1, operative from Oct. 1, 1944. Carbolic acid, 60's, anthracene, creosote oil (hydrogenation), coal tar oils (timber preservation, &c.), and strained anthracene oil controlled by the Coal Tar Products Prices Order, 1943, dated Oct. 20, 1943 (S. R. & O. 1943. No. 1528), operative from Nov. 15, 1943. Naphthalene now controlled under S. R. & O. 1944, No. 1051, operative from Sept. 22, 1944.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Scotland Oct. 14.

A steady throughput is maintained with prices unchanged. Refined tar*: Yield to distillers is 4½d. per gallon *ex* Works, naked. Creosote oil: Timber preserving quality,* 5½d. to 6½d.; hydrogenation oil,* 5¾d.; low gravity or virgin oil,† 7¼d. to 7½d.; benzole absorbing oil,* 6½d. to 8d. per gallon. Refined cresylic acid* is 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha†: 6½d. to 7d. per gallon. Solvent naphtha*: Basic prices delivered in bulk, 90/160 grade, 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 2d. per gallon. Pyridine†: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

* Price controlled. † Uncontrolled.

Although markets were quiet and irregular at the opening last week, conditions became much brighter towards the close. British Funds showed a rising tendency, while home rails received a distinct fillip on the news of the companies' civil aviation scheme. The industrial section also produced some bright features.

Despite the publicity given recently in the financial Press to gas stocks and shares, very little additional turnover has taken place. Doubtless this is largely attributable to the fact that these securities are now even more tightly held than in the past, and only forced sales are available on the market. The yields at most prices are certainly attractive but, in the absence of business, quotations are remaining unchanged in the majority of cases.

The following few quotations were altered during the week:

OFFICIAL LIST

Bombay (x.d.)	34/6—37/6	Oct. 9
Imperial Continental	113—116	+2
Primitiva Holdings	10/6—12/6	+-/6d.
South-Eastern Gas Corporation Ord.	21/—22/-	+-/3d.
South Metropolitan Ord.	94—97	−¾
Wandsworth 5 p.c. Deb.	123—128	+1

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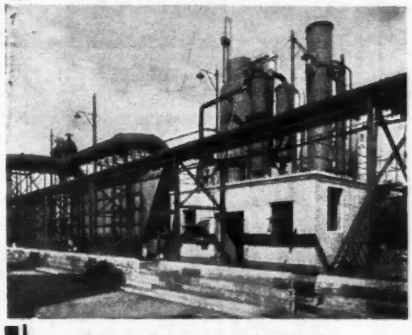
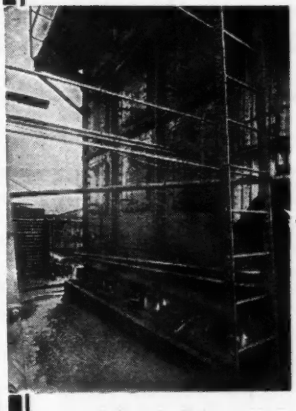


"Permac" Joints in a Gas Works.



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